CROSSRAIL

East meets West

UNDERGROUND

Network SouthEast

The planning and design of CrossRail is continuing to evolve. The information contained in this brochure is provided in good faith and is based upon the best knowledge available at the date of publication. However, developments in the Project may cause this information to change. For further details please contact:

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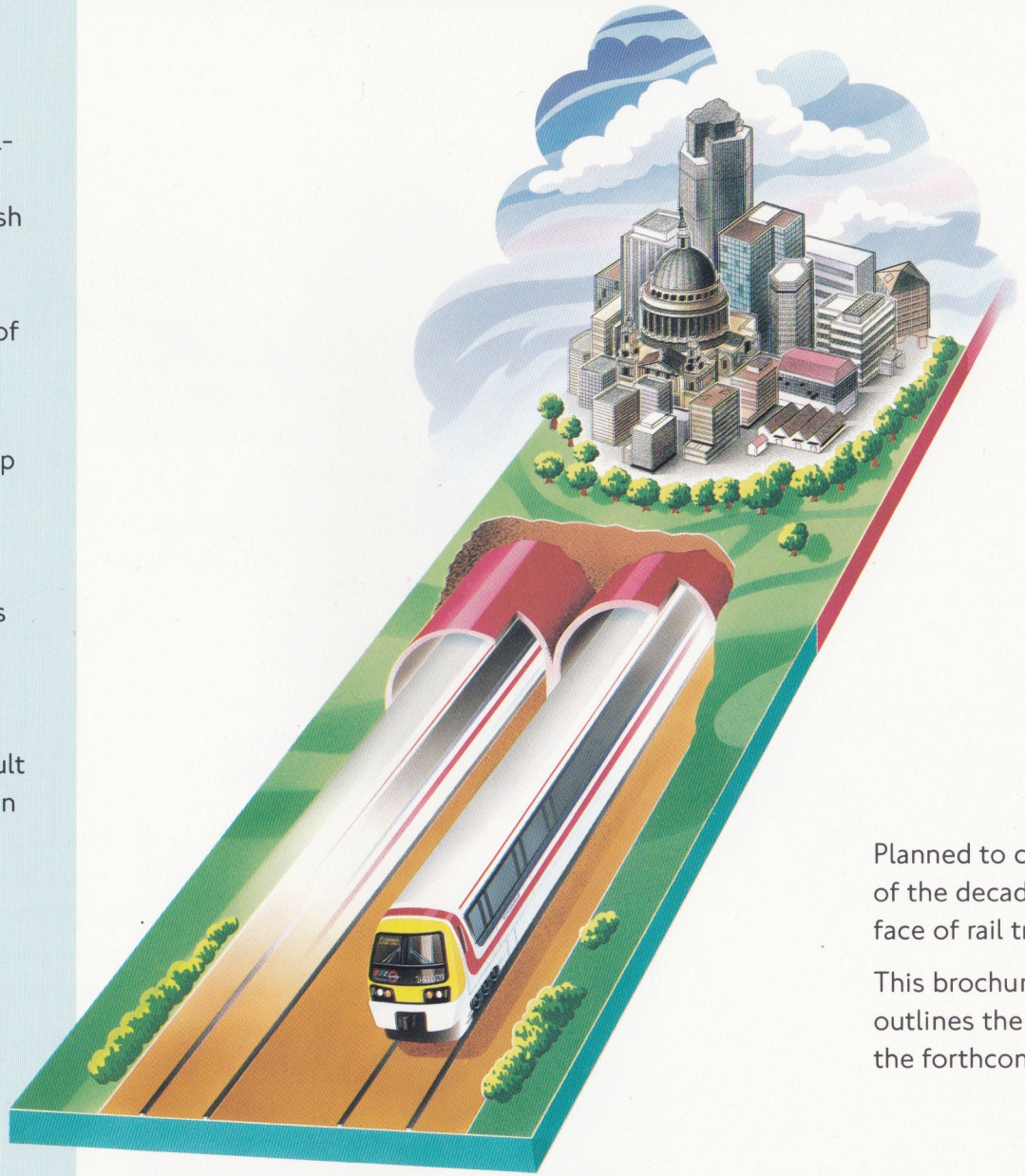
CROSSRAIL

Introduction to CrossRail

CrossRail is an innovative and exciting rail project being developed jointly by London Underground Limited and British Rail Network SouthEast. Once complete CrossRail will link counties to the east and west of London via new twin tunnels running beneath the Capital.

Purpose-built trains, carrying up to 1100 passengers, will give speedy and direct journeys to the West End and City from routes as far outside London as Aylesbury, Reading and Shenfield. CrossRail will offer passengers access to a wider choice of travel routes as a result of new and upgraded stations in the Central London area.

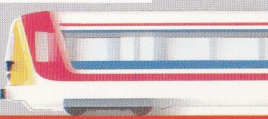


Planned to commence passenger service at the end of the decade, CrossRail is poised to change the face of rail travel in London and the South East.

This brochure introduces the CrossRail Project, outlines the benefits of the scheme and looks at the forthcoming development stages.

UNDERGROUND

Network SouthEast



Origins of CrossRail

The Central London Rail Study

In 1988/89 a joint study by the Department of Transport, British Rail Network SouthEast, London Regional Transport and London Underground Limited resulted in the publication of the Central London Rail Study report. This examined the problems faced by the current rail transport network and proposed several solutions, taking into account anticipated steady growth in passenger numbers towards and beyond the turn of the century. The report recommended several new rail lines and identified CrossRail as the most effective option to relieve congestion on existing lines and cater for future growth.

Status of the proposal

In October 1990, the Secretary of State for Transport gave the go-ahead for the deposit of the Bill. Following extensive preparatory work, the CrossRail Bill was deposited in Parliament in November 1991 seeking the necessary powers to construct the line. The detailed design work has progressed and in January 1993 an Additional Provision to the CrossRail Bill, seeking amendments to the original scheme, was submitted to Parliament.

Subject to Parliament's consent and the provision of funds, construction work could begin on CrossRail in the middle of the decade with passenger operation commencing at the end of the decade.

Public consultation

A Project Team set up by London Underground and Network SouthEast handles preparatory work, public information, consultation and design management. The Team has already undertaken extensive consultation with local authorities, interested parties and community groups. Presentations, exhibitions and discussions will continue throughout the Project's life.

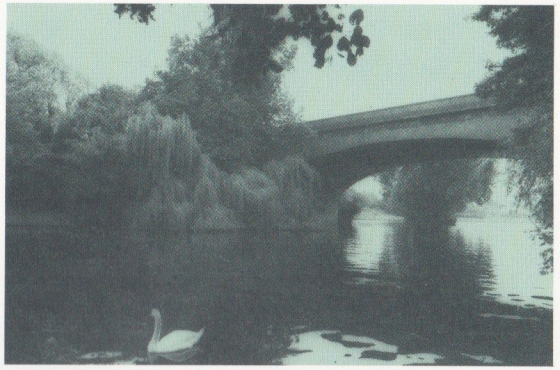
CROSSRAIL

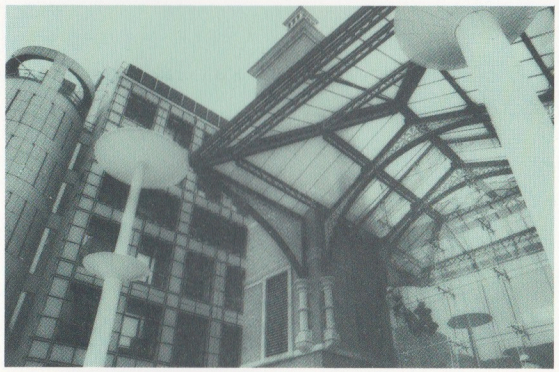
Environmental assessment

Drivers Jonas, a firm of chartered surveyors and property consultants, was commissioned by London Underground and British Rail to produce an environmental assessment of CrossRail.

In March 1991, a preliminary report was published which identified key issues. This report has provided the basis for continuing consultation with local authorities and other interested parties. Further detailed work was carried out to satisfy the requirement for a formal Environmental Statement to accompany the CrossRail Bill at the time of deposit in Parliament in November 1991.

An Addendum to the Environmental Statement was published in January 1993 to accompany the Additional Provision to the CrossRail Bill.





The Environmental Statement and the Addendum cover the following topics:

- *description of the Project*
- *description of the major works*
- *noise and vibration*
- *road traffic*
- *spoil disposal*
- *ecology*
- *aquatic impacts*
- *air quality*
- *utilities*
- *settlement*
- *visual impacts*
- *impacts on the built environment*
- *road closures*
- *land and building acquisition*

Copies of the Statements and non-technical summaries can be purchased from either of the addresses given inside the front cover. Alternatively they can be inspected at local authority offices.

UNDERGROUND

Network SouthEast

CROSSRAIL

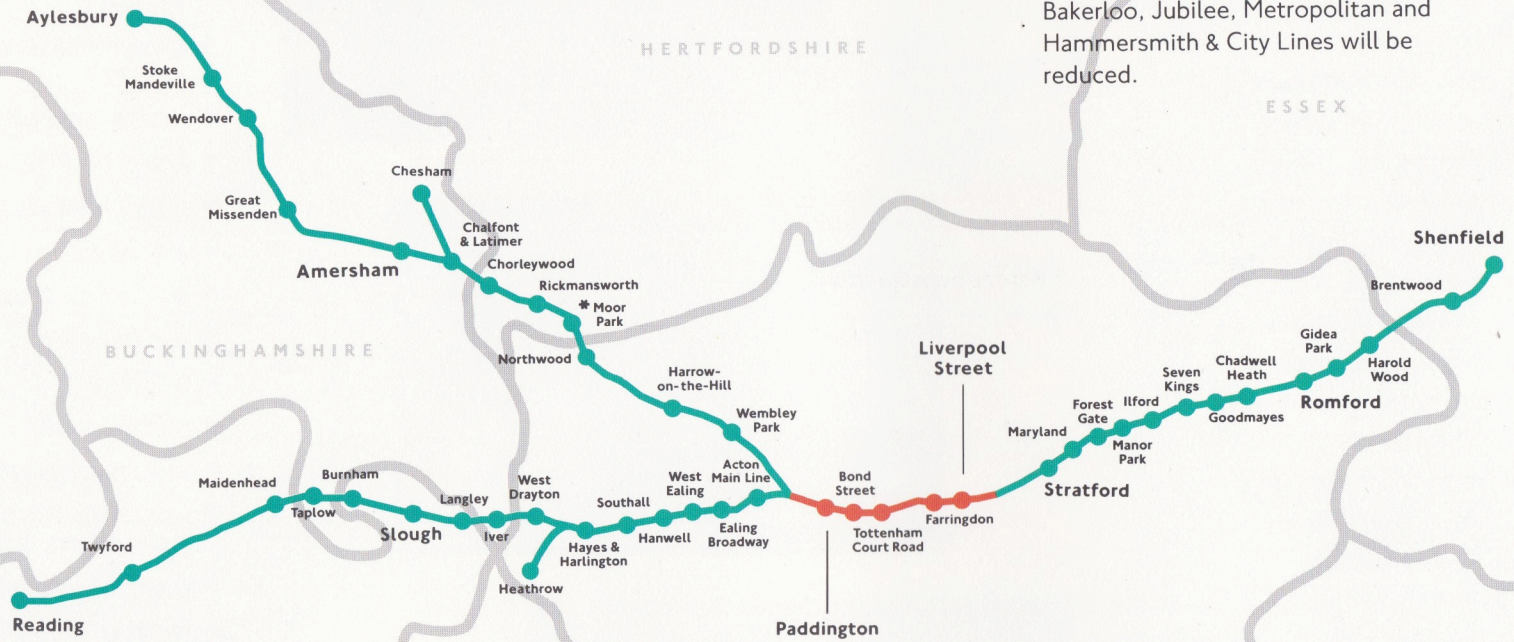
The proposed route

From the east, CrossRail trains will run over existing suburban tracks from Shenfield, via Romford and Ilford, until they reach the vicinity of Bethnal Green where they will join the new track leading to the tunnels to be constructed under Central London.

From the west, the route runs along the Thames Valley from Reading to Paddington over existing lines. The Aylesbury to Paddington route runs via Amersham, Harrow, an existing freight line between Neasden and Acton Canal Wharf and a new surface link between Acton Canal Wharf and Old Oak Common.

New tunnels will be constructed to run under Central London, serving stations at Paddington, Bond Street, Tottenham Court Road, Farringdon and Liverpool Street/Moorgate.

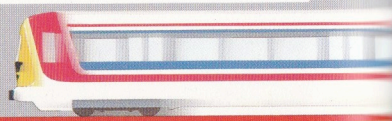
There will be Central London station interchanges with eight London Underground lines along with British Rail services at Paddington, Farringdon, Moorgate and Liverpool Street. At Stratford, passengers will be able to change to the Docklands Light Railway and the proposed Jubilee Line Extension, in addition to the Central Line and Network SouthEast outer suburban services. West of Central London, there will be opportunities to interchange to the District and Central Lines and Network SouthEast services.



*Possible station

The line will use purpose-built trains, suitable for running both above and below ground. Many passengers will be able to reach the City and West End without having to change trains at Paddington and Liverpool Street. At the same time, congestion on the Central, Bakerloo, Jubilee, Metropolitan and Hammersmith & City Lines will be reduced.

CrossRail will provide rapid journey times across London-approximately ten minutes between Paddington and Liverpool Street compared with the present time of 20 minutes or more, depending on the route taken.



UNDERGROUND

Network SouthEast

Benefits of CrossRail

The CrossRail Project will mean:-

- Faster journey times into and across the heart of London
- A new design of more spacious trains
- Increases in the capacity of the rail system
- Improved public transport access for London
- Reduced passenger congestion on other train services, particularly on the Central Line and at Paddington, Liverpool Street and other stations
- Reduced road traffic

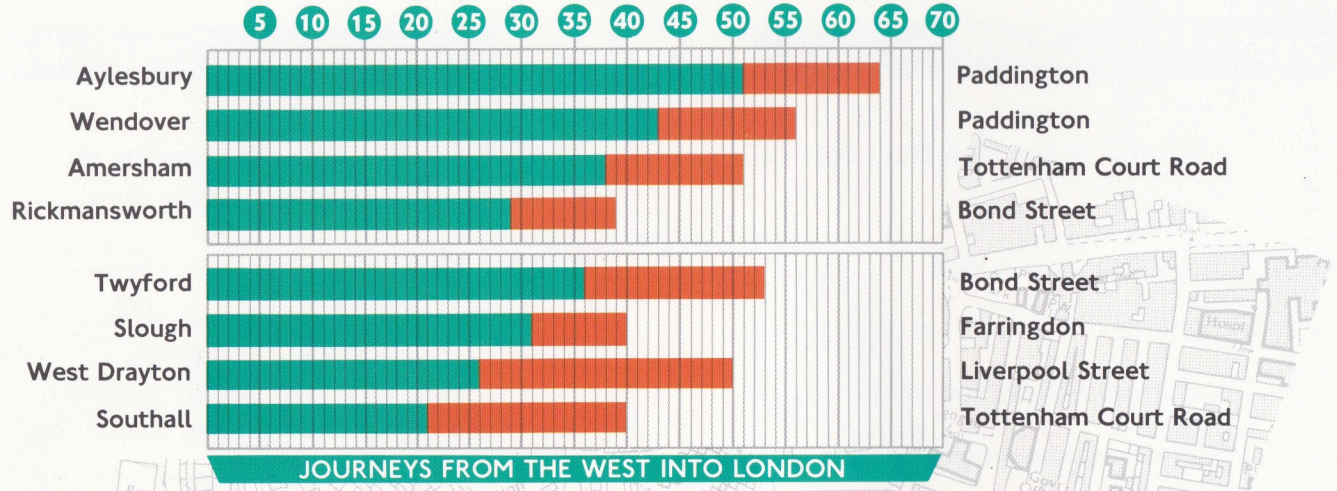
In particular CrossRail offers:-

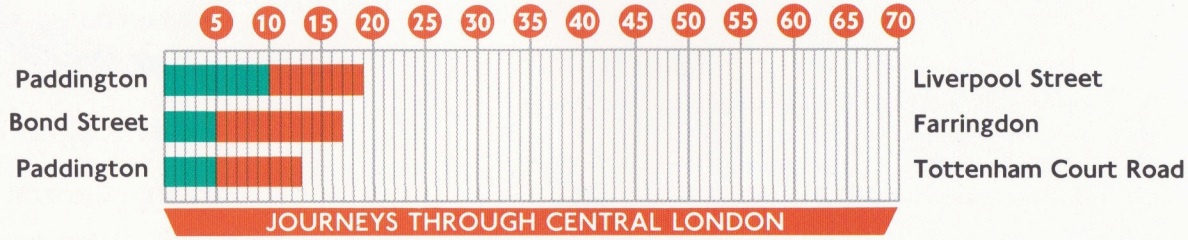
- A flexible and strategically vital link for London between the rail networks east and west of the Capital
- A high frequency train service - initially planned to be 24 trains per hour in each direction during peak periods in the Central Area
- Nineteen station interchange opportunities with existing London Underground and British Rail services, including links to Heathrow, Gatwick and Stansted airports
- Fast east to west and cross-London journeys without the need to change
- Direct services to the City and West End from parts of Buckinghamshire, Hertfordshire, Berkshire and Essex
- Connection with Network SouthEast's Thameslink - London's north-south rail line - at Farringdon
- Interchange with the proposed Heathrow Express at Paddington
- Potential for direct stopping services to Heathrow
- Large Central Area stations with double-ended access and ticket halls to serve a wide catchment area

CROSSRAIL

Journey times

It is envisaged that CrossRail will operate a service for 20 hours per day. Compared with existing suburban services, CrossRail will aim to provide more trains per hour and offer considerably reduced journey times as the following examples show.





ESTIMATED CROSSRAIL*

APPROX CURRENT*

*Relates to current timetable

UNDERGROUND

Network SouthEast

Trains per hour

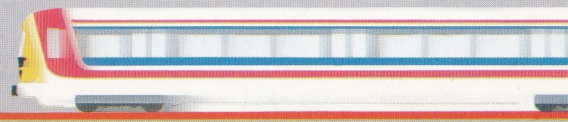
At peak times CrossRail is expected to operate up to 24 trains per hour in each direction through the central section of the route. Not all trains will operate over the entire route. A number of "turn back" points are planned on both the eastern and western branches. This is how the service could look.

Trains per hour (peak periods)

Westbound	From Shenfield	4
	From Brentwood	8
	From Gidea Park	18
	From Chadwell Heath	22
	From Ilford	24

Eastbound (Reading Branch)	From Reading	4
	From Maidenhead	6
	From Slough	10
	From Hayes	14

Eastbound (Aylesbury Branch)	From Aylesbury	4
	From Amersham	10



CROSSRAIL

The route in the outer areas

General

Beyond the Central London tunnel section, CrossRail will, in the main, run over existing rail tracks, with the exception of a short length of new line near Acton. The service will be provided by electric trains using the 25kV overhead power system throughout.

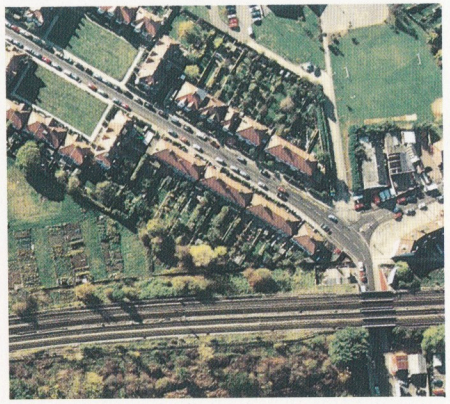
East of London

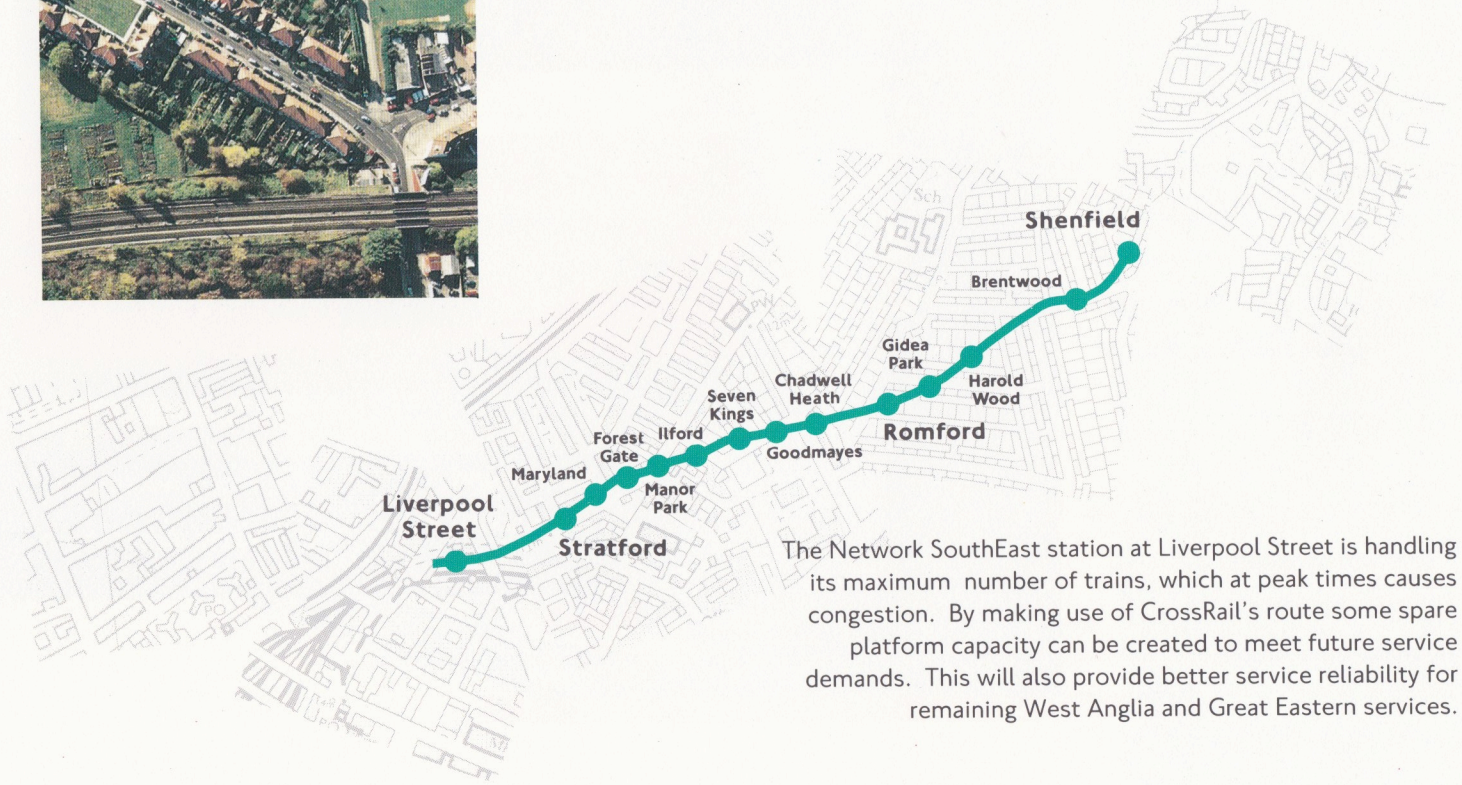
Between Shenfield and Liverpool Street, all existing Network SouthEast stopping services will become part of the CrossRail service. CrossRail will link with tracks coming from Liverpool Street main line station in the vicinity of Bethnal Green.

Stratford is already an important station interchange between Network SouthEast, London Underground services and the Docklands Light Railway. It will be the first CrossRail surface-level station after the central section tunnel. With the arrival of the proposed Jubilee Line Extension from Green Park and the possibility of a future Channel Tunnel Rail Link, Stratford's significance will be greatly enhanced.

CrossRail's proposed timetable offers 24 trains per hour in the Central Area in each direction during peak travelling times. Of these, four are currently planned to start from Shenfield, four from Brentwood, ten from Gidea Park, four from Chadwell Heath and two from Ilford. Getting to the West End will be quicker and more convenient, because there will be no need to change trains at Liverpool Street or Stratford.

CrossRail trains will be able to carry more passengers than trains presently on the route to Shenfield and the Central Line. Added to this will be a more frequent service resulting in a considerable reduction in the current levels of congestion on Network SouthEast and London Underground.

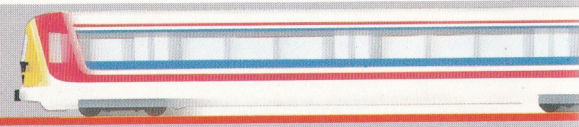




The Network SouthEast station at Liverpool Street is handling its maximum number of trains, which at peak times causes congestion. By making use of CrossRail's route some spare platform capacity can be created to meet future service demands. This will also provide better service reliability for remaining West Anglia and Great Eastern services.

UNDERGROUND

Network SouthEast



CROSSRAIL

The route in the outer areas

West of London

CrossRail's underground route from Liverpool Street will surface near Royal Oak to the west of Paddington. The line will have two branches, one to Amersham and Aylesbury, the other to Slough and Reading.

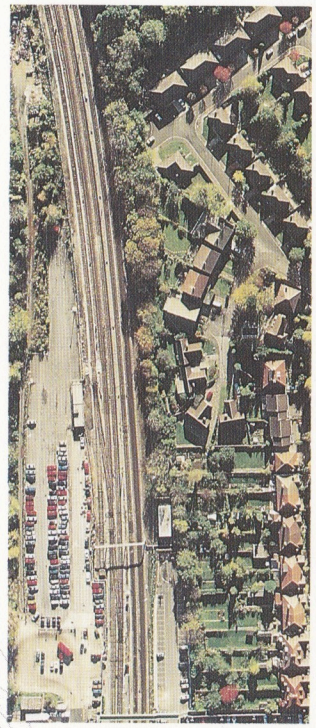
During peak periods, four trains per hour will operate from Aylesbury and six from Amersham. A service from Chesham is also proposed. On the Reading branch, four trains per hour are planned to operate from Reading, two from Maidenhead, four from Slough and four from Hayes and Harlington. There is also the possibility for CrossRail stopping services to Heathrow.

Some new track construction and upgrading will be necessary in the Old Oak Common area to link existing lines to the Dudding Hill freight line. There will also be signalling and track improvements on the existing London Underground Metropolitan Line and the Chiltern/Thames Valley Lines, to accommodate higher speeds and differing service patterns.

To accommodate the longer eight-car CrossRail trains, platforms will need to be lengthened at most existing Network SouthEast and London Underground stations in the outer areas. Rickmansworth station will be relocated locally to the east because of platform constraints at the present site.

Subject to consultation concluding in the early part of 1993, new platforms on the existing Metropolitan Line fast tracks at Northwood could provide a station interchange with the local Metropolitan Line service to Watford.

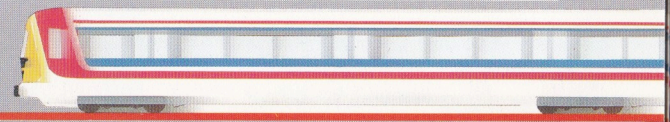
New platforms on the Network SouthEast lines at Wembley Park will create a station interchange with the Metropolitan and Jubilee Lines.



*Possible station

UNDERGROUND

Network SouthEast



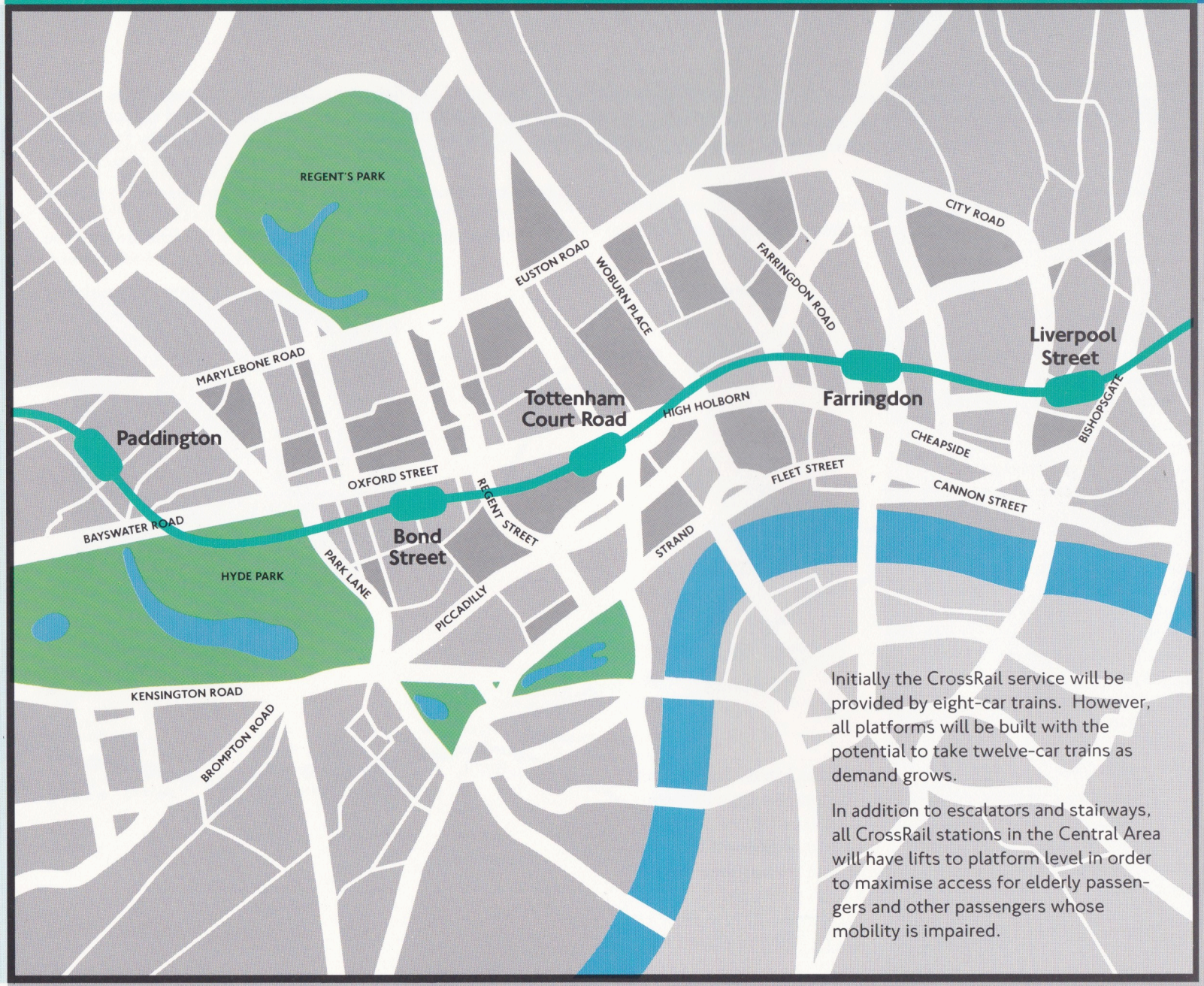
Central Area stations

CROSSRAIL

One of CrossRail's main aims is to provide effective congestion relief on existing Network SouthEast and London Underground services, particularly on the Central Line and on Network SouthEast services terminating at Liverpool Street. Station interchanges will be provided with many other London Underground and British Rail services, as demonstrated on page 11.

Special attention is being given to the design of passenger movement in the CrossRail stations in the Central Area. The underground tunnels and passageways will be larger than those within the existing Underground system. With customer comfort in mind, they are being designed to convey a feeling of light, air and space.

Because the stations are intended to accommodate large numbers of passengers, they will be double-ended. This means they will have ticket halls with entry and exit points at either end of the platforms similar to London Underground's existing stations at St James's Park and Knightsbridge. This will also enable the stations to serve a much wider catchment area than many existing stations and will provide alternative exits in an emergency. To accommodate the new generation of CrossRail trains, underground station platforms will be much longer than at present.



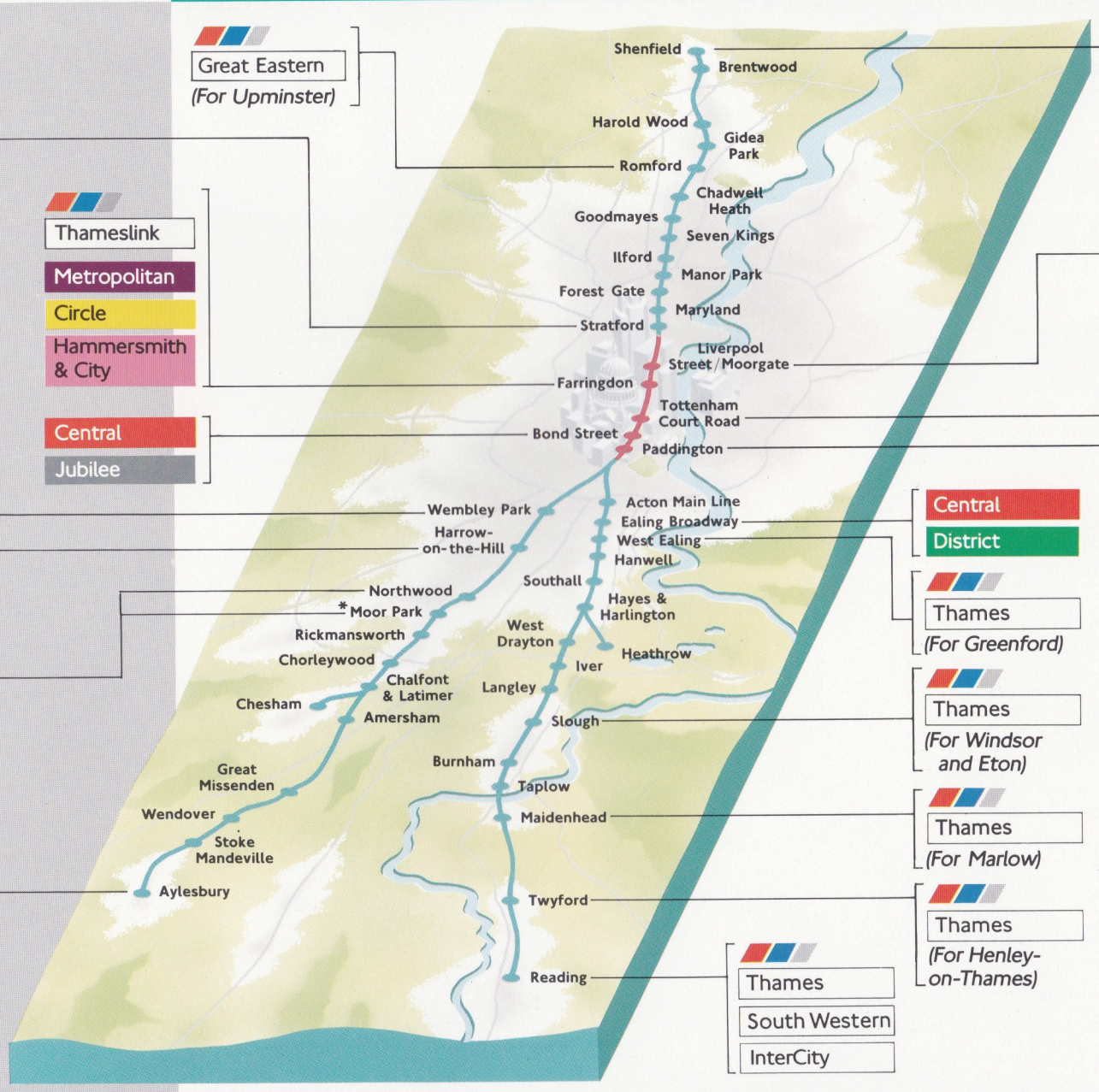
Initially the CrossRail service will be provided by eight-car trains. However, all platforms will be built with the potential to take twelve-car trains as demand grows.

In addition to escalators and stairways, all CrossRail stations in the Central Area will have lifts to platform level in order to maximise access for elderly passengers and other passengers whose mobility is impaired.

UNDERGROUND

Network SouthEast

Principal station interchanges



Central
Docklands Light Railway
(future Jubilee extension)

North London Lines
Great Eastern
West Anglia

Great Eastern
(For Upminster)

Thameslink
Metropolitan
Circle
Hammersmith & City

Central
Jubilee

Jubilee
Metropolitan

Metropolitan
(For Uxbridge)

Metropolitan
(For Watford)

Chiltern

Great Eastern

(future Chelsea Hackney)
Central
Northern

Great Eastern
Great Northern
West Anglia
InterCity
Hammersmith & City
Metropolitan
Circle
Central
Northern

(planned Heathrow Express)
Thames
InterCity
Hammersmith & City
Circle
District
Bakerloo

Central
District

Thames
(For Greenford)

Thames
(For Windsor and Eton)

Thames
(For Marlow)

Thames
(For Henley-on-Thames)

Thames
South Western
InterCity

***Possible station**

CROSSRAIL

Paddington

The proposed station at Paddington will have two ticket halls and will be situated to the south-west of the British Rail station below Eastbourne Terrace.

One ticket hall will be located under the road near the north end of Eastbourne Terrace. The second ticket hall will be an expansion of the existing Underground ticket hall beneath the British Rail main line concourse.

Interchange routes will be available between CrossRail and the District and Circle Lines, Bakerloo Line, Hammersmith & City Line and British Rail main line services.

UNDERGROUND

Network SouthEast

CROSSRAIL

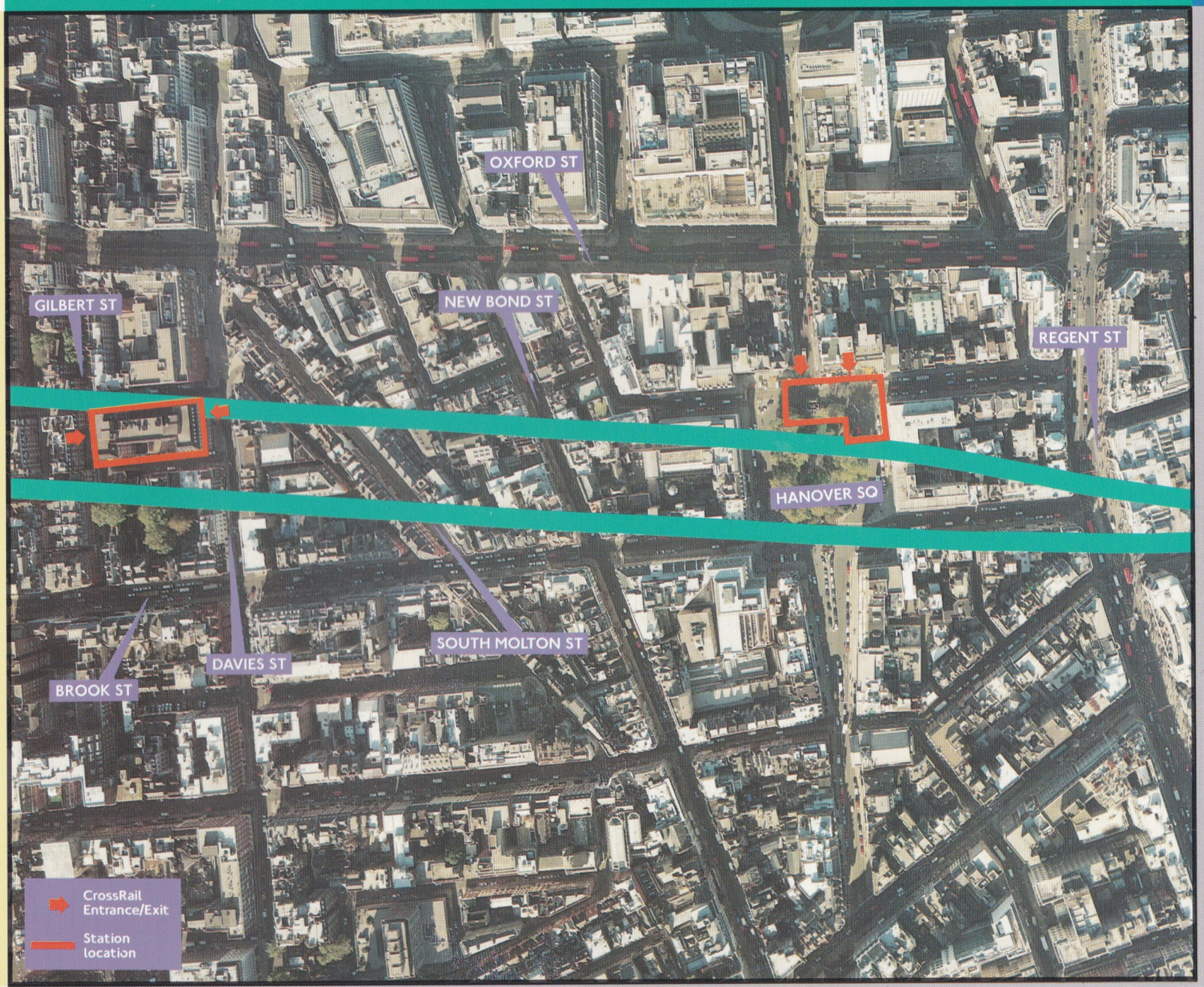
Bond Street

The proposed CrossRail station at Bond Street will be double-ended, serving a large catchment area from Oxford Street, Regent Street and Bond Street.

The western ticket hall will be at basement level in a new development in Davies Street.

At the eastern end of the station, a new ticket hall is proposed below Hanover Square, close to Oxford Circus and Regent Street.

In addition, new passages will be built to allow passengers to change easily between CrossRail and the Central and Jubilee Lines.



UNDERGROUND

Network SouthEast

CROSSRAIL

Tottenham Court Road

The existing Tottenham Court Road station carries about the same number of passengers as Heathrow Airport every day, and is severely congested at peak times. Alterations planned for the station, in conjunction with the construction of CrossRail, will result in the relief of congestion.

Passengers using the proposed CrossRail station will have easy access to Oxford Street, Tottenham Court Road and Charing Cross Road from two new ticket halls. The western ticket hall will be at basement level in a new development near the junction of Oxford Street and Dean Street. Staircases will link this ticket hall to a new entrance on Oxford Street. At the eastern end, a large ticket hall will be provided on the south-west corner of Oxford Street and Charing Cross Road, linked to the existing ticket hall with its stairways to the three other corners of this important road junction.

Parliamentary powers to construct this ticket hall and connections to the Northern and Central Lines have already been obtained through the London Underground Safety Measures Act 1991.

Each of the Underground lines passing through this station, including CrossRail and the proposed Chelsea/Hackney Line, will be accessible from both ticket halls. In addition new passageways will be built to make transferring between CrossRail and other lines at Tottenham Court Road as convenient as possible.

UNDERGROUND

Network SouthEast

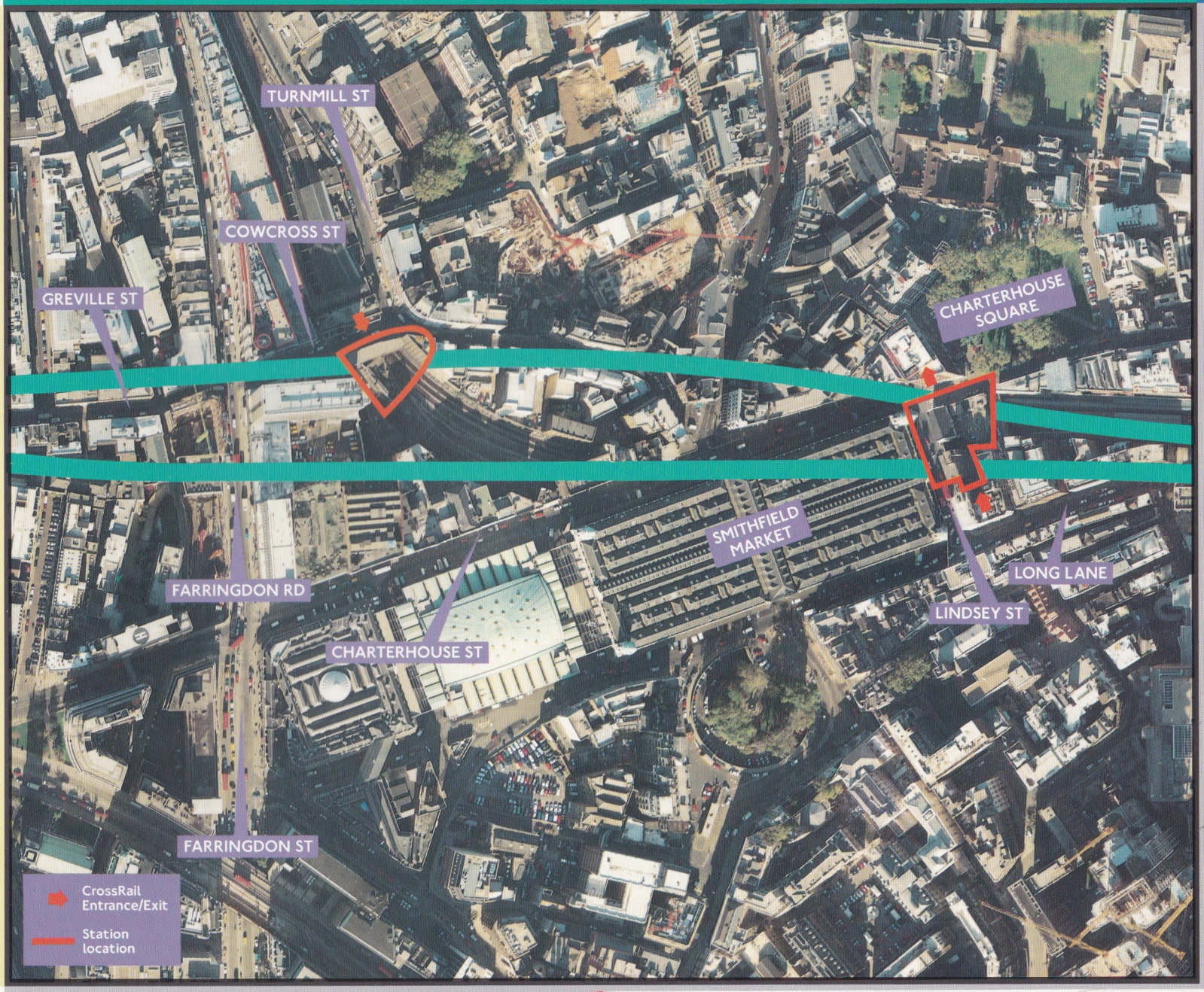
CROSSRAIL

Farringdon

Two new ticket halls are being planned for Farringdon station.

The western one will be at ground level to the south of Cowcross Street on a raft constructed over the Thameslink and Circle/Metropolitan Line tracks opposite the existing Metropolitan Line ticket hall. A series of escalators is planned to link street level with the CrossRail platforms.

At the eastern end, a new ground level ticket hall with an entrance on Lindsey Street is planned. This ticket hall will give direct access to CrossRail and Circle Line platforms at Barbican station.



UNDERGROUND

Network SouthEast

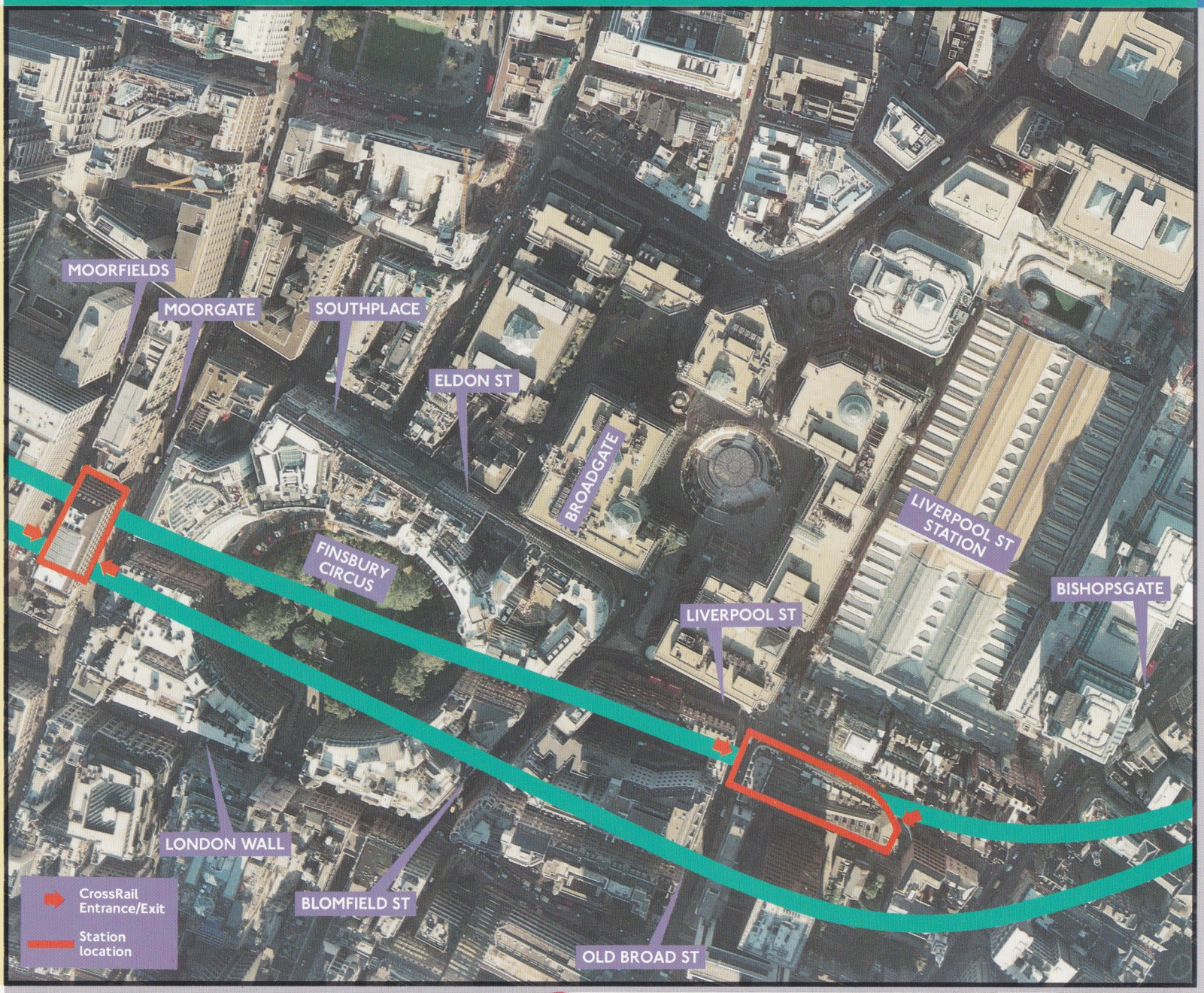
CROSSRAIL

Liverpool Street / Moorgate

CrossRail platforms at Liverpool Street will be served by two new ticket halls at the existing Liverpool Street and Moorgate Underground stations.

At the western end, a new underground ticket hall with stairs and escalators leading to street level is proposed adjoining Moorgate, north of London Wall. In addition to direct escalator links to the CrossRail platforms, access is planned from this ticket hall to the Circle, Metropolitan and Hammersmith & City Lines as well as to British Rail services and the Northern Line at Moorgate.

At the eastern end, the proposed ticket hall will be located on a raft constructed over the existing Circle/Metropolitan Line platforms. It will provide escalator links to the CrossRail platforms, and give access to the Circle, Metropolitan, Central, Hammersmith & City Lines and British Rail main line services.



UNDERGROUND

Network SouthEast

CROSSRAIL

Trains for CrossRail

The Class 341 train is designed to provide CrossRail customers with fast, safe and comfortable travel well into the 21st century.

A comprehensive design programme based on ergonomic evaluation and stringent safety standards, together with experience gained from Network SouthEast's "Networker" train project, has produced a train suitable for both short and longer distance journeys.

UNDERGROUND Network SouthEast

Trains for CrossRail

Interior layouts make ample provision for both seated and standing passengers; the three sets of wide, power-operated plug doors in each car enable speedy entry and exit and space is available for wheelchair bound passengers. A wheelchair accessible toilet compartment will be provided in each four-car train. All materials used for interior construction and finishing will comply with the latest fire safety requirements for both underground and surface operation.

The colourways and lighting of the interiors will create a spacious ambience, enhanced by the wide gangways linking carriages. There will be air-conditioning throughout the train.

Information about the journey will be provided in-car by state-of-the-art visual and audio systems.

The latest technology will provide an extremely reliable and energy efficient train, with high performance characteristics and low maintenance requirements.

Computer-controlled condition monitoring systems will help ensure high availability for service by providing better information about the train for maintenance personnel.

One feature of the exterior is the use of bonded ribbon glazing which will contribute to reduced maintenance and provide every seat with a clear window view.

Two power units per four-car train will provide a dramatic improvement in acceleration, resulting in faster journey times.

Safety developments

Body strength: Each coach will be formed as a tube, bringing a major advance in integral body strength and incorporating the latest requirements for energy absorption

Coupling strength: Rigid couplings throughout each unit to prevent deflection or derailment

Seating strength: New design and anchoring to withstand higher forces

Braking force: Two braking systems with automatic changeover making maximum use of recovered energy. Includes full emergency brake and anti-skid protection

Incident monitoring: A black box recorder fitted

ATP (Automatic train protection): Production ATP equipment fitted. (Pilot schemes currently being installed on Chiltern Lines and London - Bristol route)

Communication alarm: Direct voice communication link between passengers and the driver

Secure radio: Direct voice communication between driver and signalling centre

Consultation and construction

Consultation Programme

An extensive programme of information and consultation with identified interested parties began in October 1990 and will continue throughout the Project.

The programme includes meetings with Members of Parliament, local authorities, community and residential groups, and local displays of information where staff are available to answer questions. Notice of meetings and exhibitions is given locally.

Parliamentary and Construction Programmes

Up to November 1991

Consultation / information

Referencing and Bill preparation

Engineering feasibility study

PRE PARLIAMENTARY

From November 1991

BILL DEPOSIT - November 1991

ADDITIONAL PROVISION DEPOSIT - January 1993

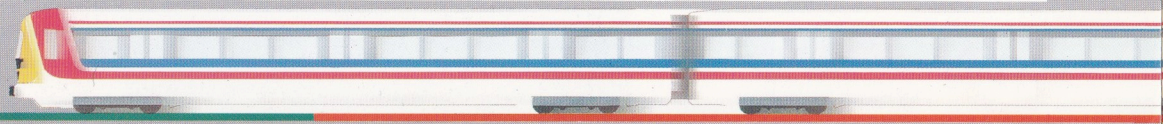
Consultation / information

Presentation of design and engineering proposals

PARLIAMENTARY PROCESS

Subject to the consent of Parliament and the provision of funds, work could begin around the middle of the decade and conclude around the end of the decade

CONSTRUCTION



CROSSRAIL

Principal engineering features

The Central London alignment

The many existing tunnels beneath Central London, such as the Post Office Railway, deep-level sewers and the new Thames Water Ring Main as well as London Underground lines, have made it difficult to develop an alignment for CrossRail. Deep building foundations, both existing and proposed, have further complicated this task.

Despite these problems, it has been possible to keep the new line at about the same depth as the Central Line for most of its length, that is about 21 metres (approximately 70 feet) below street level. The only exception is at Liverpool Street where CrossRail must pass beneath the other Tube lines making it around 30 metres (approximately 100 feet) deep at this point.

The tunnels

The twin circular tunnels will be larger than those of existing deep level Underground lines with an internal diameter of about 6 metres (approximately 20 feet), compared with 3.8 metres (approximately 12 feet). This is to accommodate the larger size of Networker type trains to be put into service on CrossRail, and the associated overhead electrification equipment. The tunnels will also accommodate passenger emergency walkways.

For most of their length, it has been possible to locate the 9.3 km long (6 miles) tunnels in the London Clay, ideal ground in which to bore tunnels. On the eastern section, however, part of the tunnels will be located in the top of the Woolwich and Reading Beds, which lie below the London Clay. This ground generally consists of clay with sand layers, possibly with some water, which may require particular attention during construction.

The tunnels will be lined internally throughout by either curved, segmental concrete rings expanded directly against the clay, or iron rings bolted together with grout pumped behind them to fill the gap between the rings and the clay.

Spoil removal by rail

In order to keep the number of lorries removing spoil in the Central Area to a minimum, the tunnels will be bored simultaneously from two large sites at either end and meet in the middle near Tottenham Court Road.

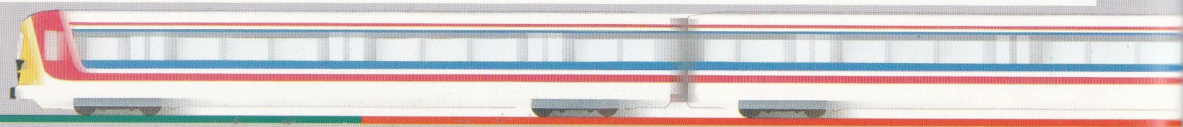
The advantage of this method is that removal of much of the spoil and delivery of the tunnel linings can be by rail. Four large tunnel boring machines will be used, each taking about three years to complete its work. Approximately half of the total of two and a half million cubic metres of spoil will be removed by rail, thereby keeping the surface lorry movements to a minimum.

Central London stations

The Central London stations require separate working sites in their immediate vicinity. Land suitable for working sites is not readily available and at Hanover Square (Bond Street station) and Finsbury Circus (Liverpool Street station) it will be necessary to use public gardens for this purpose. Once construction is complete and these sites are no longer required, the gardens will be reinstated. Elsewhere, it is hoped to combine working site requirements with other building development projects in order to lessen the impact.

The platform level of the stations will be formed primarily by tunnelling beneath existing buildings and streets to provide escalator and lift shafts, platform tunnels and passageways to connect ticket halls, platforms and other Underground lines.

A number of smaller sites along the route will be required between the stations to construct ventilation and emergency access shafts.



UNDERGROUND

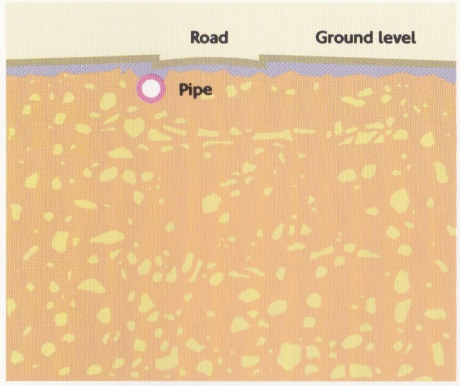
Network SouthEast

Covered way construction

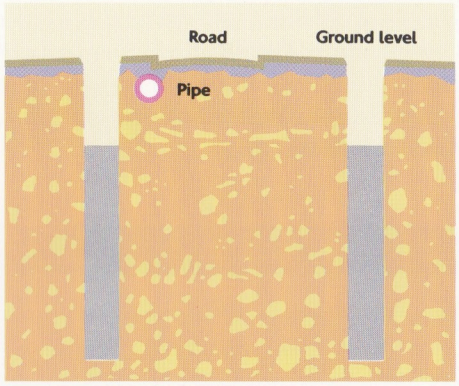
As the twin tunnels rise towards ground level at the tunnel portals, it becomes increasingly impracticable to construct them by boring beneath the surface. Hence, when insufficient cover for the tunnels is available, covered ways will be built, plus, at the eastern end only, a length of new viaduct, to connect to the existing surface railway tracks.

A covered way is, in effect, a shallow box-shaped tunnel constructed by digging a large trench from ground level, putting a concrete lid on top, and reinstating the ground over it (see illustration). CrossRail has been designed to keep the length of the covered ways as short as possible.

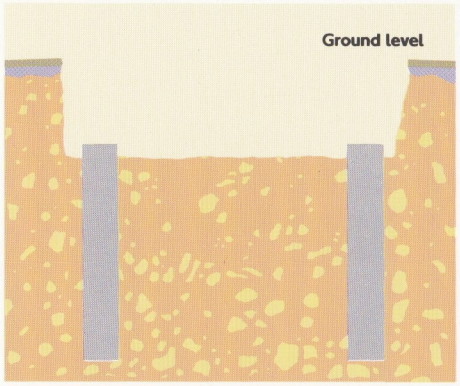
The covered way construction will usually be of the 'top-down' type. This means that the walls are built first, then the roof is put on before removing the ground between the walls from an access opening left in the roof. The ground over the covered way can be reinstated at a relatively early stage in construction.



1 Before construction

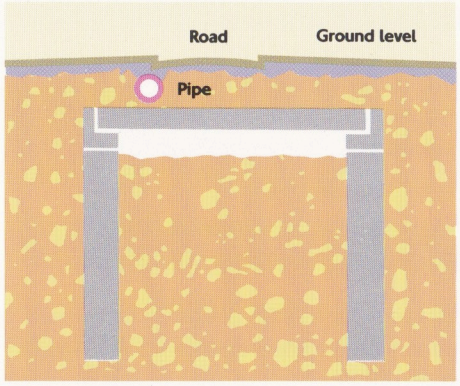


2 Piling: Concrete tunnel walls are formed by bored piles filled with wet concrete.

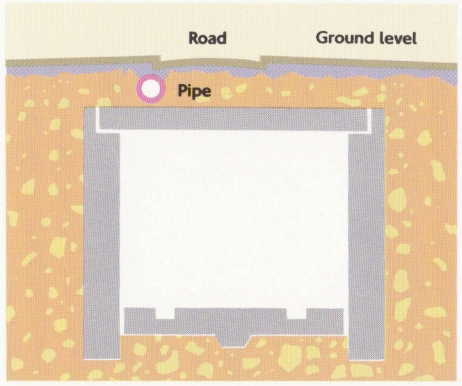


3 Surface excavation: The ground is excavated to the level of the tunnel roof.

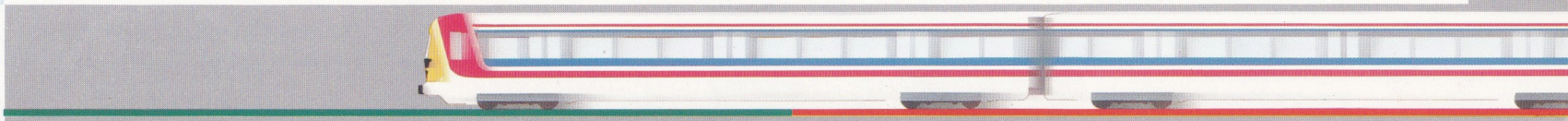
4 Roof construction: The piles are topped with reinforced concrete. Then a pre-stressed concrete roof is installed.



5 Reinstatement: The ground above the roof of the tunnel is replaced, together with any roads, pipes, etc.



6 Tunnel excavations: The area between the piles is excavated and the spoil removed.



CrossRail's place in the network

CROSSRAIL

The proposed route through the Thames Valley and Central London links CrossRail with most rail and Underground networks north of the Thames. Proposed new lines and extensions currently being considered would also connect with CrossRail, including the planned Heathrow Express Link.

CrossRail is an integral part of the planned improvements which will dramatically enhance London's public transport network and satisfy anticipated demand into the 21st century.

Jubilee Line Extension

The proposed Jubilee Line Extension is expected to open this decade. This will see the Jubilee Line extended from Green Park to Westminster and south of the Thames to Waterloo, London Bridge, and on to Docklands and Stratford in east London. Stratford will become a major interchange station providing direct transfers between the Central Line, existing Network SouthEast services, the Docklands Light Railway and CrossRail. There is also the exciting prospect of the possibility of a future Channel Tunnel Rail Link.

Jubilee Line Extension

Heathrow Express

The Heathrow Express Bill was granted Royal Assent in May 1991. Subject to British Airports Authority/British Rail agreement on a range of issues the proposed high speed rail link to the Capital's premier airport would run from Paddington. CrossRail passengers would be able to transfer to the Heathrow Express Link at Paddington thus benefiting from a fast link between the City and Heathrow Airport. There is also the parallel possibility of a direct Heathrow stopping service from Central London on CrossRail.

Heathrow Express

CrossRail passengers will also find that they have easy access to Stansted Airport. A dedicated service started in March 1991 between Liverpool Street and the Airport.

Thameslink 2000

CrossRail will connect with existing Thameslink services at Farringdon. Network SouthEast plans to extend dramatically this service, known as Thameslink 2000, to provide substantial additional north-south links from Bedford, Peterborough, Cambridge and Kings Lynn to Portsmouth, Brighton and Kent.

Thameslink 2000

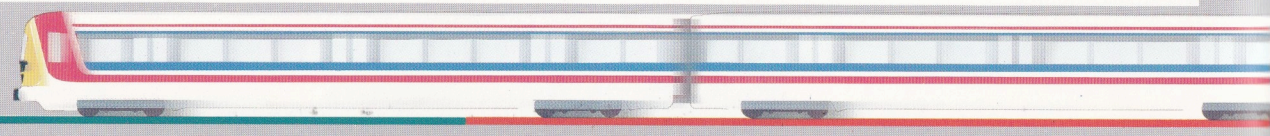
Chelsea/Hackney Line

Another prospect is the proposal by London Underground for a new line with an important CrossRail station interchange at Tottenham Court Road station. The Chelsea/Hackney Line is planned to run from Wimbledon through Putney Bridge, Parsons Green and Chelsea in the south-west of London to Leytonstone in the north-east. It will take over either the Epping or Hainault via Newbury Park branch of the Central Line, providing major relief for the Victoria Line. It will also, for the first time, provide an Underground service for Dalston and Hackney.

Chelsea/Hackney Line

UNDERGROUND

Network SouthEast



Room for expansion

Initially CrossRail stations will be served by eight-car trains. However, in anticipation of future needs, the plan makes provision for twelve-car trains. It will also be possible to increase the service from 24 to 30 trains per hour, given the provision of appropriate signalling facilities.

CrossRail, in conjunction with all the other major proposals, offers a unique opportunity to improve rail services in London while at the same time reducing congestion.

CrossRail will provide all services between Moor Park, Chesham, Amersham and Aylesbury

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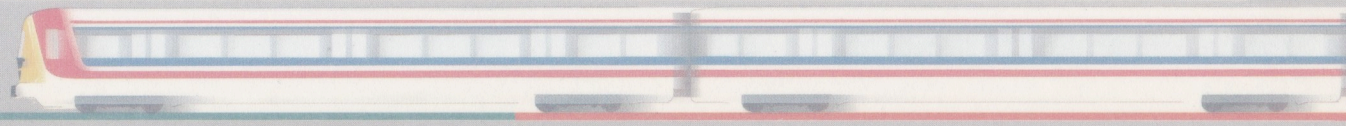
Journey Planner correct at January 93



CrossRail's place in the network

CROSSRAIL

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Journey Planner correct at January 93

The planning and design of CrossRail is continuing to evolve and further changes will be made. The information contained in this brochure is provided in good faith and is based upon the best knowledge available as at April 1993. If you would like any further information please contact:

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